

# SCIENCE

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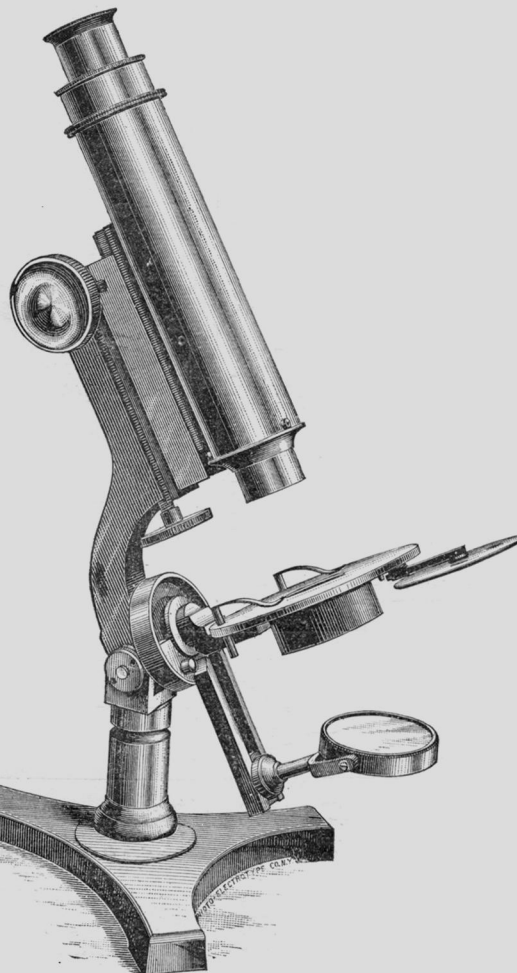
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# SCIENCE:

A WEEKLY RECORD OF SCIENTIFIC  
PROGRESS.

JOHN MICHELS, Editor.

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SATURDAY, JUNE 4, 1881.

THE Zoological Society of London has made an interesting addition to their gardens, by building an Insectarium for rearing insects in captivity, watching their transformations, and making a thorough study of their life history and habits.

The building erected for the purpose is a substantial structure of iron and glass, the cases containing the insects being arranged on stands all round the building, and occupying two tables in the centre. These cases are formed of zinc, the upper part glazed on all four sides, and the top arranged with a perforated zinc cover for the purpose of admitting air.

The Insectarium has been opened with an exhibition of specimens of some of the larger and finer species of silk-producing moths of the family Bombycidae. Among these more specially noticed by a correspondent of "*Nature*" are Glover's Silk-moth (*Samia Gloveri*), and the Cercopian Silk-moth (*S. cecropia*) of North America, Perny's Silk-moth (*Attacus Pernyi*) of Northern China, the Tusseh Silk-moth (*A. mylitta*) of India, and the great Emperor Moth (*Saturnia pyri*) of Europe. "These have been imported from their native countries in the stage of chrysalis. Of the first three above named, many examples are already hatched, and the splendid *imagines*, or perfect insects, are appearing one by one. Soon after appearing the sexes unite and eggs are produced, after which the parents quickly perish. The fertilized eggs remain to produce caterpillars, which eventually form a second set of pupæ or chrysalises, and thus continue the species."

"On the north side of the Insectarium the smaller cases are devoted principally to the rarer and more noticeable moths and butterflies of Europe, such as the Swallow-tailed Butterfly (*Papilio machaon*), the Black-veined Butterfly (*Aporia crataegi*), the Purple Emperor (*Aptaura iris*), and the Orange-tip (*Antho-*

*charis cardamines*) among the former, and the Scarlet Tiger Moth (*Callimorpha dominula*) and the Emperor Moth (*Saturnia carpinii*) among the latter group. The series is continued, mixed with other forms, at the east end of the building. On the large tables in the middle of the Insectarium are examples of other butterflies, moths, beetles, mayflies, stoneflies, and aquatic insects of different kinds, all well worthy of attention and study. The whole series exhibited, now contains examples of about fifty species, but daily additions are made to it."

The establishment of the London Insectarium may be the means of calling the attention of our authorities to the necessity of establishing a similar institution in this country, where an Insectarium is much more needed than in Europe. The United States Congress has granted large sums for scientific investigations, in the hope that means might be suggested for mitigating the ravages of insects. Twenty-five thousand dollars represented the expenses of the Entomological Commission, the report of which will be noticed in our issue of next week. A large proportion of this sum was devoted by the Commissioners to an exhaustive examination of the brain of the locust and other interesting histological work.

It appears to us that such histological work might be well accomplished in an Insectarium, and twenty-five thousand dollars would be a very handsome appropriation for such an establishment; the work could then be concentrated, the mental and physical attributes of insects, with all their habits of life, could be studied in a systematic manner. This arrangement, with reports from the field, would probably cover more work than has been accomplished in this direction by previous commissions.

Perhaps under the new management of the Agricultural Department the propriety of establishing an Insectarium may be considered, for the Commissioner would have no difficulty in securing a competent entomologist to take charge of it.

LOCALIZATION BY THE EYES.—Professor Helmholtz recently addressed the Physical Society on the localization of objects by the eyes. We estimate distance with one eye by the outlines of the more distant objects being covered by the nearer one where they meet, and by the shadows thrown by the anterior objects. These conditions are very rarely overpowered by others, as for instance, binocular vision. This is shown by Dove's pseudoscope, and the fact that closing or blinding one eye makes little difference to the power of judging distance, especially when not very close to the eye. The relative shifting of objects as the eye is moved from side to side, or to and fro, or up or down, which may be called the parallax of motion, is also a strong factor in estimating distance. He concludes from a study of the stereoscope that the perception of the absolute convergence of our eyes is very indistinct, and that only differences of convergence related to apparently near or distant objects produce the stereoscopic effect.

## SLEEP AND SOMNAMBULISM.\*

BY M. REGNARD.

[Translated From the French by the Marchioness Clara Lanza.]

## I.

LADIES AND GENTLEMEN:—When the eminent *savant*, who acts as President of your society, requested me to talk to you about Somnambulism, I frankly own that I hesitated for a long time before accepting his proposition. It almost seems as if there were things in Science which we should leave undiscussed, subjects which a prudent man never takes upon himself, the task of exposing dangerous topics, in short, with which it never benefits one to meddle. Somnambulism, or animal magnetism, as it is still called by persons who persist in employing an erroneous term, certainly belongs to this category.

It is a mystery, inasmuch as it is only known by its effects, and it has always struggled, from remote ages up to the present day, against two classes of people—dupes who believe all that is told them, and charlatans who seek to impose upon the world.

I made this observation over and over again to myself, scarcely desiring to class myself among either of these sets; but one thing alone decided me to address you. I knew that I should speak to an audience at once kind and enlightened, one accustomed to listen to scientific truths, and to master the facts submitted to it. I could not doubt that the rich discoveries recently made in physics had taught you to be astonished at nothing, and to renounce nothing *a priori* in the dominion of Science. You should, therefore, place yourself in precisely the same position in regard to Physiology and Medicine.

In the short space of time reserved for me, I shall consequently endeavor to the best of my ability, to teach you what intelligent men accept and profess relative to that singular nervous malady called Somnambulism.

Gentlemen, our immortal comic poet, Molière once said that opium makes us sleep because it possesses soporific properties. This phrase, although apparently a bitter criticism upon Medical Science, is in reality a definite, exact and complete expression of a scientific fact. Opium makes us sleep because it possesses soporific properties. It is impossible for us to say anything further even at the present day. For should we observe that it makes us sleep because it congests the brain, we must add also that this arises from the fact that it possesses the faculty of causing congestion. This, however, is not a solution of the problem.

These things you may say however, have nothing to do with Somnambulism, but it was necessary to make the foregoing remarks in order that you might fully understand the aim and significance of this lecture. I shall place facts before you, show you experiments and, I trust, gain your conviction. I shall prove everything to you, but explain nothing. Science is bound to substantiate facts, determine the conditions in which they occur, but it is not required also to furnish the explanation. Why does a body that we let slip from our hand fall to the ground? Why is the earth attracted by the sun? Why does oxygen unite with hydrogen? Why does one piece of iron surrounded by a galvanic current attract another? We do not know. We see that these facts exist, we can prove them, but we cannot explain.

Why then should we not treat Somnambulism in the same way? This nervous affection only seems extraordinary to us because we are not accustomed to it. It is infinitely less strange than the physical effects I mentioned to you, for it is a mere consequence of simple physiological facts which no one endeavors to authenticate. Let us remain true to our purpose, however, examine the facts and remove all the extravagant ideas which have arisen. Let us prove without attempting to explain.

In the first place we must be in guard against fraud. It is the business of a clever and experienced man to avoid deception, and the few physicians who state that this is impossible only succeed in proclaiming the inferiority of their intelligence. If all the years of hard work they have passed through have not placed them in a position whence they are able to recognize the trickeries of mountebanks and hysterical girls, we are left to conclude that they have little profited by their education. I wish therefore, in the beginning, to make you fully comprehend that I shall only mention well attested facts, and that I shall wholly repudiate those which have not been universally witnessed, or which are so far removed from physiological truth that it has been deemed prudent to keep them still in reserve.

Somnambulism is a disease; it is a nervous affection, and one which we are able to combat, treat, and cure. It consists in the alteration of a physiological function, in a modification of sleep. We must therefore begin with sleep for it is necessary to understand the normal function before entering upon its modifications.

One of the greatest of nature's laws is that repose must succeed action. Our organs are not capable of performing their various functions indefinitely. Even the heart which apparently beats incessantly, rests a certain time between each pulsation, and instead of reposing a long while, after continued activity like the rest of the body, it relaxes for a brief space after each period of motion.

The brain is no exception to the general rule, and requires rest after having worked all day. It then ceases to act, partially at least, leaving other nerve centres, the spinal cord for instance, to govern whatever remains active among the functions of the organism.

As to what becomes of the mind, during that time, I really am unable to say. It does not enter into my course of study, and moreover, if I intended to discuss important psychological questions, I should be continually reminded that in this very chair where I enjoy the perilous honor of speaking, Jouffroy and Cousin have already given you the full benefit of their learning. I should consider it a sort of profanation to bring before you, brief perceptions, a feeble echo, so to speak, of what has already gone before me, when it is so easy for you to have recourse to the admirable rules of these illustrious teachers.

Besides, I only desire to study the purely physiological character of sleep.

A certain portion of those who have occupied themselves with the subject, affirm that sleep is our normal condition. Our birth is an awakening, our death merely a return to our primitive state, while life is simply an episode where this eternal slumber is interrupted by a series of vigils and periods of activity. Buffon was less exclusive and stated that sleep was a form of existence as real and general as any other. "All organized beings which have no sensations exist in this manner," he said.

We will not linger, however, to contemplate these broad considerations. Let us rather return to our post of observation and see what happens when a man falls asleep.

The first manifestation of this state is relaxation of the muscles. The entire body becomes, as it were, annulled; the arms fall, causing the book they supported to drop; alas! sometimes, as most of us know, the head descends abruptly forward, which causes us to wake frequently, and produces anything but an agreeable sensation. After this, the senses gradually sleep. Apparently sight is the first to become abolished. The outside world disappears, and a dream begins. Frequently, particularly in children, an astonishing spectacle is presented. When awake we should call it a kaleidoscope, or an exhibition of fireworks represented by various brilliant hued flames of all shapes, passing before us rapidly,

\*A lecture delivered before the *Association Scientifique de France*.

then suddenly fading away. Sleep is not far distant, but it is not fully established, for the sense of hearing is still awake.

This sense indeed, seems to be last to succumb. How many times, when on the point of dropping asleep, have we heard our name suddenly pronounced or a particularly interesting observation uttered; we arouse with a start exclaiming, "I was just going off, I was already in dreamland."

We might say that the sense of hearing by the very persistence of its activity contributes to the production of sleep. Does not a monotonous sound often induce the state? When amid the universal silence of Nature we hear the ceaseless lapping of waves along the sea coast, or a soft wind swaying among the trees, do we not become drowsy in listening? In infancy, an analogous mechanism, the singing of our mother or nurse, causes our senses to sleep rapidly while our ears are still sensible to the impression of sounds.

I could furnish you with innumerable examples. How many times has the monotonous discourse of a rambling and wearisome orator caused your eyelids to close involuntarily. The mind struggles at first and then abandons itself. The words succeed each other like the uniform ticking of a clock; the meaning is gradually lost upon the listener, and only when the speaker finally stops, does he awake with a start.

I have but little to say of the sleep of smell and taste. They seem to be quickly abolished and, apparently, do not even persist in dreams. A certain man who, although not a *savant*, was nevertheless a very minute and shrewd observer, Brillat-Savarin, calls our attention to the fact that it is excessively rare that we experience either the sense of smell or taste in sleep. When we dream of a beautiful garden or a field of flowers, we see the blossoms without inhaling the perfume. If we imagine ourselves to be present at a bountiful repast, we observe the dishes, and may even partake of them without tasting them.

Touch does not seem to be much behind sight in becoming abolished. But on the other hand, a slight impression in this respect is sufficient to drive sleep completely away. It is pretended, you know, that a rose leaf upon the bed was enough to prevent the Sybarites from sleeping. Recognizing the possible exaggeration, let us, however, recall some of our traveling experiences and think of the hard beds at the different hotels, which in spite of our intense fatigue kept us awake for so long.

While we become thus gradually deprived of our faculties, the organic functions continue to perform their work without ceasing; only, nothing is subject to our control, everything occurs automatically. This last word will reappear so frequently throughout this lecture that I will pause for a moment to explain to you the precise sense in which I employ it.

In ordinary life our will never sleeps. It regulates the exercise of our organs and presides over the accomplishment of all our acts. Some of these, however, are so habitual that we execute them, as we say, without thinking. Thus, for example, we expand the chest when we experience a desire to inhale the air. Sometimes we do this voluntarily, but more frequently the act is purely mechanical, and in the same way we execute a thousand different motions with the thorax in the course of an hour without being in the least aware that this is the case, without even knowing that the desire to breathe makes itself apparent. This, of course, does not mean that the causes which produce the inclination do not exist. I simply intend to say that their effect does not reach our understanding. It stops *en route* and does not go as far as the brain. It is reflected upon the spinal cord, and gives rise to what is called *reflex action*.

In a normal state, the impressions which are made upon the surface of the body are conveyed directly to the brain; the latter immediately determines the order, so to

say, in which the organs react. Suppose for instance that you burn your finger. A sensation of pain is transmitted to the brain, and instantaneously your muscles are made to contract, and you draw back your arm. It very often happens, however, that the arm is drawn back before the brain has had time to comprehend the dangerous situation of the finger. This is owing to the fact that the sensation has already made a vivid impression upon the spinal cord *en route*, and this nervous centre causes the arm to be withdrawn although the mind as yet knows nothing of what has occurred. The sensation, therefore, is reflected upon the spinal cord as though the latter were a mirror, and this is what is meant by reflex action. You see how simple it is to understand. I could go on and multiply such examples *ad infinitum*. Sneezing, swallowing and the motions of the viscera are all reflex actions governed entirely by the spinal cord.

Do you wish for proof? A single experiment will give it to you. Here is a frog whose head you see I have just cut off. It has no longer a brain and consequently no sense of any kind. It can neither feel nor exercise any will power. I now place a drop of acid upon its foot and you see that the latter is violently withdrawn. It makes frantic efforts to remove the acid. This is all due to the spinal cord which produces a series of combined reflex actions.

You are thinking, perhaps, that we are still very far away from Somnambulism. On the contrary, we are in its immediate neighborhood, for I will show you presently, that the somnambulist is a being whose brain is temporarily abolished, and who, like the decapitated frog, acts in a purely mechanical way.

To be brief, the physiological characteristic of sleep is the comatose condition of all the senses combined with voluntary movements produced by reflex action. The latter we find in dreams.

When our senses fall asleep, they convey to our understanding a final impression, which results in the last idea that we receive, and *vis-à-vis* to which, our conceptive faculty, our intelligence, is, so to speak, completely free. It then happens that this idea produces a more vivid impression, and that with the rapidity of thought it can give rise to a long chain of imaginary ideas which develop and which our still conscious mind (the perception alone being annulled) accepts as real. This chain of ideas is a dream. If the chain is well made the dream will continue methodically; if defective, we have those absurd and ridiculous dreams which sometimes, recalling the following day, cause us to smile.

In every case nothing can be more rapid than a dream. It has the precise duration required for a chain of ideas born solely of the imagination, and a dream that we often think has lasted all night, has in reality occupied the brain but a few moments. On how many occasions have you awakened several times successively after you have fallen asleep. In the few moments between each period you had a long dream, and were it not for the clock which informs you of the incontestable fact, you would swear you had been asleep for hours.

Thus, many physiologists and psychologists think that a dream is nothing more than the prolongation of ideas proceeding from a final impression produced in the mind by the senses at the moment when sleep overcomes them, or else the result of an impression formed upon the mind while it is yet awake, and the senses asleep.

The proof that this is the case is contained in the fact that in certain subjects it is possible to produce dreams and to regulate them at will. With some chlorotic young girls, for instance, the sounds produced in the arteries reach the ear and are conveyed to the brain during sleep—dreams result which are always the same. The young girl from the city will dream of a ball or concert; another, whose religious tendencies are more developed will imagine she hears the singing of angels and the hymns of saints, while a country girl will dream of

wind stealing through the foliage, of rain pattering against the window panes, the gentle murmur of a brook, or the soft twittering of birds. The senses furnish the first idea, the imagination does the rest. I told you it was possible to regulate dreams at will. With certain persons subject to nightmare, a sudden exclamation, an unusual sound can change the whole course of a dream, waken a portion of the brain, and cause the sleeper to reply to a question put to him, which proves that his dream has conformed itself to the suggestions of whoever speaks.

This, gentlemen, is the normal state. Exaggerate it, and you are in the presence of that nervous malady called Somnambulism.

Sleep, abolishing perception, but not conception; a dream that another person may modify according to suggestion; automatic action consequent upon the lethargy of a portion of the brain and the predominance of the spinal cord. This is the conception of that famous affection which appears to be so incomprehensible, when we do not take the trouble to analyze it, or else when we investigate it superficially.

You see I did not deceive you when I said it would be necessary to study sleep in order that we might comprehend the maladies arising from it.

Now, what is sleep physiologically dependent upon?

If we remove the top of a dog's skull while the animal sleeps, thus exposing the surface of the brain, we see that during this state it presents a whitish appearance, while it becomes pink as soon as the dog awakes. It has also been observed that the brain assumed this rosy hue when the dog executed a series of automatic movements, which led to the belief that he was dreaming. Sleep was therefore the result of a sudden anæmia of the brain, and a man or an animal can be put to sleep by simply pressing upon the carotid arteries in the neck; that is to say, by preventing any blood from going to his brain. These things, however, are rather problematic, and I prefer to leave them in the background, that I may give my full attention to the *diseases of sleep*.

The first important modification is the excess of sleep, what we call stupor or lethargy. These terms, I am sure, will produce very different impressions among you. Some of you will recall those terrible stories which have been told us independent of proof, in which it is said that people affected in this way have been buried alive. Others will remember the fairy tale called "The Sleeping Beauty," in which a lovely lady sleeps in an enchanted palace awaiting the arrival of Prince Charming. It is probable, however, gentlemen, that all these stories are false, although science can confirm the possibility of similar fables.

You will doubtless be intensely astonished when I tell you that the Sleeping Beauty may have actually existed. What will you say when I tell you she is alive now and in Paris! It is nevertheless true, that in one of our hospitals, of which I shall frequently speak, La Salpêtrière, there is a woman forty-five years of age, who, to my certain knowledge, has slept for more than a year without waking. By giving you her history I will make you familiar with the principal characteristics of stupor. This woman entered the hospital in consequence of paralysis of the lower limbs. For twenty years she has been unable to move from her bed, and in that time has grown excessively stout. Her intelligence is of the most mediocre order, but her general health has always been good and her disposition exceedingly quiet. A few days prior to her strange attacks, she becomes suddenly very agitated, speaking continually with the utmost volubility and bursting into such violent fits of laughter that everyone about her involuntarily joins in the hilarity. All know the meaning of this behaviour, and the superintendent informs the physicians that the *sleeper* will soon become insensible. Her laugh gradually ceases, her eyes close, her arms fall lifeless, and in this condition she re-

mains sometimes for a week, sometimes for a year. During this time she is nourished with a stomach pump, and no exterior excitation whatever can rouse her. From time to time she sighs heavily, and then relapses again into stupor.

The photograph that I have here will show you how closely this state resembles death externally. It shows you also just how this woman remains for months at a time pale, motionless, and in no way manifesting any sign of life, although she is far removed from death.

This is the lethargic type which after all is merely a long, profound sleep, probably filled with dreams.

Finally, the woman awakes, and is surprised to find snow and ice outside instead of the green leaves and brilliant blossoms of spring.

The second state, resulting from a modification of sleep, is Somnambulism.

This celebrated malady, gentlemen, must be divided into two parts. First we have natural Somnambulism, which arises spontaneously and develops independently, and secondly, induced or artificial Somnambulism, which results in those machinations improperly termed magnetic. This distinction, I think, is well founded, for even if the effects of the two affections are similar, their nature is quite different. You will understand this when I have made you familiar with both.

A considerable number of physicians call spontaneous Somnambulism *Automatism*, and this word seems to me infinitely preferable to the ordinary term. It admits of no confusion, to begin with, and it expresses a clear idea of the nature of the disease.

There are several degrees of Somnambulism. The most simple is a sort of intellectual sleep, the senses and organs being awake, or partially so. You recollect that in natural sleep we saw the intelligence persist, although all the muscular masses had already succumbed. Here we have the contrary in the sleep of the intelligence while the organs possess the appearance and activity of waking moments.

You know that during long night watches many women have fallen fast asleep and continued to knit or spin assiduously. All their movements were perfectly normal, but if spoken to they did not reply, for they slept. I know a little girl twelve years of age who has frequently presented the following singular fact to my notice. While walking with her father and mother along a flat, uninteresting road, during the summer evenings, it always happened that she suddenly experienced a sensation of utter fatigue, and would cease to take part in the conversation. When addressed she made no answer, for she slept as she walked. Her steps continued to regulate themselves with the others, and only when shaken lightly did she awake.

I recollect having often been told by mountain guides that in making night ascensions it is necessary to ply the whip every moment to the horses to prevent their falling asleep. One of the directors of an omnibus line in Paris said to me the other day, that the horses in the evening constantly slept while walking or trotting.

This is really Somnambulism, for the term signifies walking while asleep. Natural Somnambulism, however, is quite different, and instead of defining it accurately I will give you a certain number of incidents in which you will find it represented in all its phases.

At the time when I was employed at the *Hôpital Saint Antoine* I was fortunate enough to witness, together with Dr. Mesuet, M. Maury, and several other eminent men, one of the most curious cases of automatism that has ever been recorded.

The person was a Zouave who had received at Bazeilles, a terrible wound on his head, which left his brain partly exposed. This unfortunate man at the time of the accident fell paralyzed to the ground in a state of insensibility. But he was picked up by the enemy, carefully nursed by them, and in due course of time recovered his

senses. His paralysis even disappeared, so that by the end of two years he was able to resume his ordinary manner of living. Being a man of considerable talent and some little education, he adopted the profession of singing in the different *cafés concerts*. Just about this time he began to be affected by the singular malady, which I am going to describe to you. On certain days he would become suddenly very depressed, then as though anxious to rid himself of the melancholy, would rise, dress and walk for hours in the streets. He advanced in a straight line, looking neither to the right nor to the left, as though observing nothing about him, and indeed he could not have seen, for he ran into various persons and objects unless his hands, which he sometimes extended before him—warned him to be more careful.

He was then, as physicians now say, in the *second state*, the first condition being the normal one. Nothing in his appearance denoted Somnambulism as far as the public was concerned, except one important peculiarity. The unfortunate man was seized while in this state with a passion for stealing, which apparently nothing could overcome. Every shining object; whether valuable or absolutely worthless became the subject of his covetousness. He would take it quietly from a stall or shop window, and put it with no sign of fear or hesitation into his pocket. He also seemed to care very little whether the proprietor of the shop saw him or not, and the presence of a policeman made no difference whatever. You can readily imagine, gentlemen, that such a manner of proceeding could not continue long in Paris without attracting considerable attention, and it was not long before this unhappy creature was arrested. The physician of the prison to which he was consigned, however, saw that the man was the victim of disease, and had him sent immediately to M. Mesuet, who thoroughly investigated his case with the assistance of his colleagues and students.

At the hospital, the patient entered the *second state* about once a month. The attack always began in the same way, by his rising and beginning to walk. Being perfectly strange to his surroundings, he always extended his hands before him, picking up every brilliant object, watches, spoons, tumblers, etc., and placing them in the large pockets of his hospital coat. We took these things away from him without any opposition being evinced on his part. He never spoke, saw nothing, heard nothing. A ray of sunlight falling directly across his eyes did not produce the slightest effect upon them. A deafening noise made close to his ear did not cause him to swerve or tremble. His skin, even, had lost all trace of sensibility. Long steel needles were run into his flesh and the skin cauterized, without producing the slightest movement on the part of the patient.

This, gentlemen, is real Somnambulism. The mind sleeps, perception and conception are both abolished, the senses are partially annulled. Organic life exists, but the person is like the frog I showed you after I had removed its brain, that is to say, its intelligence only; as M. Charles Richet says, the brain is merely asleep. It is possible to waken it completely, it is also possible to rouse it partially, or to animate a single idea which will become the origin of a dream, just as the last idea presented to us before we sleep naturally can produce a dream which lasts all night. But the dream of a Somnambalist has particular characteristics, in as much as a certain number of functions, movement among others, are still awake.

While our man was in the second state, a large cane was placed in his hand. He felt it carefully, and his face lighted up with animation. Shouldering the cane which he evidently mistook for a gun he began to walk majestically up and down. You see an idea had been roused into activity, and this idea produced others of an associating character. The dream once begun, memory intervened and we then witnessed a most curious scene. This *cé-dé-avant* Zouave began to walk cautiously all at once; then he stopped as if listening, walked a few steps further,

listened again, then suddenly drew violently back and hid himself behind a bed. He next shouldered the cane, made a motion as though cocking a gun, seized an imaginary cartridge, went through the formula of loading and took deliberate aim at this point, his eyes glared with a fierce light and he shouted with a loud voice: "Here they come, here they come! There are at least a hundred of them!" Then, he fell suddenly back upon the floor, his hand pressed tightly to his forehead. He remained as if dead; the dream was over.

On another occasion we endeavored to provoke a different dream by *suggestion*. Being a professional singer we desired to make him think he was upon the stage. A roll of white paper was handed him, at which he looked long and seriously. Simultaneously, a lighted lamp was placed beneath his eyes with the hope that it would suggest the idea of foot-lights to him. The success was complete. The patient began to try his voice, but at the same time gave evidences of being ill at ease. He finally removed his hospital coat which was replaced by a frock coat handed to him by one of the physicians. He seized it hastily, but stopped short on seeing a small spot of bright scarlet. This was a decoration of the Legion of Honor which was attached to the buttonhole. This he carefully detached and placed in his pocket. He then dressed himself in the coat, coughed once or twice and began to sing patriotic airs of which he made a specialty.

Another time, he was given paper and ink and he began to write a letter to his old General asking some trifling favor. When he had finished, the letter was hastily removed from before his eyes, leaving nothing on the table but a blank sheet which had been underneath. He began to read over his letter, holding the blank sheet in his hand, stopping from time to time to jot down a comma or period, and finally signing his name at the bottom of the page.

The patient woke naturally, utterly astonished at finding himself in bed in broad daylight, surrounded by several people, and having no recollection of anything that had taken place.

Gentlemen, this is a typical instance of Somnambulism. You have first of all, sleeping of the brain, then an awakening either by the action of the memory, or by an exterior suggestion of a single idea which forms others. This is the characteristic of that strange condition which M. Mesuet has appropriately termed the automatism of memory.

At the close of his remarks, M. Mesuet said that automatism would undoubtedly very soon be admitted into medico-legal cases. The idea which awakens in the automaton can be anything at all. With our zouave, it was one of battle, but also frequently one of theft. I will show you others who dream of suicide, assassination, incendiary, etc., and who accomplish these crimes without having the slightest recollection afterwards of what they have done. "I do not despair," said M. Mesuet long ago, "of gaining the conviction of magistrates and causing these men to be acquitted."

This hope, gentlemen, has been realized. Three weeks ago one of these unfortunate creatures was arrested, imprisoned, tried and condemned, before he had, so to speak, come to himself. When he finally awoke, it was to find himself lost, dishonored and imprisoned. He was even ignorant of the crime which he had committed.

He then called to mind that physicians had often mentioned the strange conditions into which he sometimes passed, and he summoned M. Mesner and M. Moté. These *savants*, while before the Court of Appeals, succeeded in putting him into the second state, convincing the lawyers thoroughly and causing the arrest of the first judges.

I have shown you an automatic robber. Here, now, is an assassin. One of the monks belonging to a con-



vent in the south of France, cherished a hatred, perhaps justifiably, against his Superior. One night he rose while sleeping, took a poniard which he had in his cell and crossing the cloister entered the Prior's room. The latter, instead of retiring at his usual hour, had seated himself to write at a table on which were two lamps. The monk passed before him without perceiving the light, walked stealthily to the bed and struck several blows with his poniard upon the pillow. He then stole out of the room, regained his cell and went to bed again. The next day when questioned by the Chapter of the convent, he could recollect nothing. This man although unconscious, would have been condemned unhesitatingly as an assassin.

A lady whom M. Mesner had long occasion to observe presented one of the most extraordinary cases of natural Somnambulism ever known.

With her, a sad and melancholy idea always was the starting point of her dream. She would rise from her bed in the night and endeavor to throw herself out of the window. She never saw the persons who surrounded her or paid any attention to them in any way. On the following day, all was a blank to her.

One night, she carefully steeped some *soms* in a glass of water, then seating herself at a table began to write to her family; "I wish to die," she wrote, "I shall never recover my health, my head is out of order. Farewell, by the time you receive this letter I shall have but little time to live. By to-morrow I shall have taken the fatal poison which this glass contains. Once more, farewell."

This done, she concealed the glass in a closet, as the poison, she thought, was not yet strong enough. Just as she accomplished this act, she was seized with a hysterical attack and awoke. On the following day she remembered nothing of what had occurred, and asked for her glass, which she said, some one had taken. Another was given her in its place. The next night, she rose from her bed while asleep, walked straight to the closet, opened it, and seized the glass of poison. During the day it had been replaced by a tumbler of pure water by a member of the family. As she removed the glass from the closet, the entire household, summoned by the lady's maid entered the room. Mme., however, did not perceive any of them. She was sleeping, dreaming. She threw herself on her knees before a crucifix and placed the glass to her lips. At this moment, as though seized with a sudden resolution, she put it aside, rose, and wrote the following letter to her family:

"Just as I was on the point of swallowing the deadly poison, an angel appeared to me just as he did to Abraham when the latter was about to sacrifice his son. He caught me by the arm, saying; 'Think what you are about to do; you have a husband and children.' When I heard these words my heart beat quickly and I felt overcome with conjugal and maternal love. Still, I am very ill, and my head is weak. Pardon me this fault, so great in your eyes and in mine."

This she wrote, still sleeping.

Mme. X. did many other things on various occasions just as curious, and the most wonderful thing of all was that while in her normal condition during the day, she remembered nothing she had done while asleep. She always continued any dream she may have had in previous nights, and completed it.

This leads me, gentlemen, to speak of a singular state constituted by Somnambulism. This is called *double consciousness*. The first physician to give a good description of this nervous affection was M. Azam, professor of the medical faculty at Bordeaux.

The person observed by M. Azam was named Férida X, a seamstress living in Bordeaux, whose health was moderately good, if we except the periodical attacks she was subject to.

On certain days, in the midst of her work, she would

suddenly become dull and melancholy. Her head would drop upon her breast and she would sleep so soundly that it was impossible to rouse her. Finally Férida would wake in the best of spirits. Her manner was lively and she would run about in the most exalted of moods. Several hours later, all this left her. Férida relapsed once more into gloom and silence, and gradually fell again into a sound sleep. When she awoke from this sleep she remembered absolutely nothing that had taken place during the *second state*. The next time, however, that she relapsed into this condition she recollected all that occurred on a former occasion, but could recall nothing pertaining to her normal state. She was unable to recognize persons that she had then seen. Férida consequently has two personalities—two lives—in one she is sad and gloomy, in the other gay and cheerful. While in the first state she can recollect nothing of the second state, and while in the latter condition she continues her existence, so to speak, from the point she stopped at during the previous attack. This state of double consciousness, as it is termed, seems really to be merely a species of natural Somnambulism. Modern science appears to be considerably advanced upon all these points. But you will ask, gentlemen, what antiquity thought of these phenomena, and how they were received and understood throughout the middle ages and even later times. Ancient history gives us but little information on the subject, but in my next lecture I will endeavor to tell you what was known on the subject, in spite of the imprudence I shall thereby commit by attempting retrospective science from such a distance.

## THE PHYSICAL BASIS OF GRAVIC FORCE AND LIGHT.

BY SAMUEL J. WALLACE.

If we suppose, that:

(1) Gravitation is the *work of some kinetic or live force*, because it is a first mover to do work, which we may call Gravic force; and that (2), there is an interstellar medium to convey light, called Ether, then, *is this medium capable of conveying the necessary gravic force to produce the known acts of gravitation?* And, if so, what must be the terms of its action?

To solve this, let  $a'$  be the force of light for one square foot at the earth in one second, say 100-foot pounds; let  $d$  be the distance of the sun in its semi-diameters, say 47,000, and  $a = a' d$ , the force of light from one square foot of the sun in one second, say 4,700,000 ft. lbs.; let  $b$  be one pound of matter, as in the Ether; let  $c$  be the distance of fall from gravitation, to measure foot pounds in velocity, say  $16\frac{1}{2}$  ft., and  $2c$  be the velocity gained thereby, say 32 1-6 ft.; and let  $e$  be the velocity of light, say 950,000,000 ft., in one second.

Then,  $(e + 2c)^2 c \div a' d = y$ ; and,  $b \div y = x$ , the amount of matter which would, at the velocity of light, transmit its force from one square foot at the sun, for one second; say, 1-3,000,000,000 part of one pound.

This would be at the rate of about one grain of matter in five days from one square foot of the sun; and would produce a medium at the rate of one grain in three thousand cubic miles.

The Ether may be thousands of times so dense, depending on the distance between contacts of particles; but this weight it must have.

Then, with this effective density, *what must be the velocity to produce the action of gravitation?*

Let  $h$  be the earth's orbit, say 3,070,000,000 ft.; let  $i$  be one-fourth of a year, say 7,889,400 seconds, and  $k = h \div 4 i$ , say 97,250 ft. velocity in one second; let  $l$  be the weight of the earth, say 13,000,000,000,000,000,000,000 lbs., and let  $m$  be its cross section, say 1,200,000,000,000,000 sq. ft.

Then,  $(k + 2c)^2 c l d \div i m = w$ ; the force for one sec-



ond from one square foot, as at the sun which would equal that required to change the course of the earth as it occurs in its orbit, as measured by the earth's cross section.

But, as the density increases greatly toward the centre of the earth, the full force may be much greater; say 2  $w$ , or 19,000,000,000,000,000 feet, pounds, for one square foot each second; or about 4,000,000,000 times as much as the force of light.

And, then,  $2c\sqrt{2w}$ ,  $y \div d \cdot c = v$ ; the velocity of a medium having the same quantity of matter as light put in motion in one second to transmit gravic force; say about 280,000,000,000 feet velocity in one second.

This is nearly three hundred times the velocity of light, or one and three-fourth seconds from the sun to the earth.

It may be noticed that though this would require as much weight of matter to pass one point in one second, as light, yet, as its velocity is greater, it would only take a medium of about one three-hundredth the weight to the cubic mile.

This leads to the enquiry whether there may not be two separate media, one for light and one for gravic force: which differ in *capacity for speed and the kind of effect they can produce*.

It is clear that gravic force though three or four thousand million times as great as light in actual power, yet can have no such crude medium, or at least, *mode of action*, or it would reduce the earth to vapor in the flash of a second.

Light, itself, if its force was transmitted by as crude a medium as sand, would cut away the face of the hardest rock as the sand blast does.

This indicates that *gentleness of touch increases with tenuity of medium*; and that it may co-exist with increase of speed and of power.

So we are led to suppose that gravic force *may be still greater in its velocity*. And that its medium may be still lighter in weight, while still acting as simple ponderable matter in transmitting force by motion.

The speed of gravic force may be due to *its medium having particles smaller and more simple* than those of light.

Particles in the medium of light may have a *complex structure* which takes just a little longer to communicate motion from particle to particle in the innumerable contracts taking place in the flight of force through space. In the same way we know sound takes longer in passing through a heavier or more complex gas.

Gravic force and light seem to *have a generic difference* in their nature as forms of force.

Gravic force seems to have a direct relation to the *number of primary particles in matter*, as shown by its weight; and *not to the chemical atoms and molecules*, and to the structure and condition of substance, as light does, as shown by the spectroscope. This seems to indicate a difference in the mediums, as having in light a relation to a more complex order of structure in its particles.

Heat, electricity and magnetism seem to belong to the family of light, in this respect; while mass motion as related to simple weight and to gravic force seems to belong to the family of the latter.

The forces change from one form to another under definite conditions; but seem to do so more freely each within its own family, and by some regular order or rank among the forms. Certain forms *tend to sink to lower forms by becoming weaker* or diffused through more matter; while *lower forms tend to rise to higher forms by becoming stronger*, or concentrated into less matter.

Gravic force changes into mass motion, and possibly into cohesion and its family of forces. Mass motion changes into vibration by collisions, and this changes into heat, as a sort of meeting ground of the forces, about

which there is a plexus of forms reaching up into electricity, magnetism and light.

But the general laws of action are very indistinctly made out.

*How can a simple forward projection* of a pulsation, or of *particles*, from contact to contact among themselves, *convey the complex actions of light in polarisation?*

Can it be by means something like this?

I. *The particles conveying light have FLAT FACES which in the first start of light are set square across their line of flight.*

II. *In each successive contact the particles are turned with their faces into parallelism with those behind, in receiving their motion.*

III. *In striking heavier bodies at peculiar angles the particles while changing their courses have THEIR FACES TURNED TO ONE SIDE from square across their line of flight, so as to be repeated in the successive contacts,; and,*

IV. *This sidewise inclination of faces disposes the particles to peculiar actions in striking heavy matter having faces inclined peculiarly to that of their own planes of inclination.*

Some such mechanism certainly has a very singular analogy to the action of light in polarisation, and does not do great violence to well-known laws of action as former ideas do.

But, *how can simple forward projections of particles produce all the wonderful complexity of colors?*

Could there be actions something like this?

V. *Light at its start is without colors, as SIMPLE FORWARD PROJECTIONS OF PARTICLES following each other in a continuous stream; the momenta going forward through contacts after contacts of particles.*

VI. *The continuous stream of particles in passing through media having particles of greater weight IS BROKEN UP INTO PULSES having times in which the new particles could move or receive and deliver their motion, forming an intermittent stream.*

VII. *The continuous pulsing stream of particles on striking reflecting or refracting matter is separated into parts following each other in relation to the times of movement of the particles of such matter; so that,*

VIII. *The peculiarly vibrating particles of such bodies DIFFERENTLY reflect, refract, absorb, or act on, successive portions of the pulsing or continuous stream of particles of light which strike them DURING DIFFERENT PARTS OF THEIR VIBRATORY PATHS; or, according to DIFFERENT CAPACITIES OF THE VARIOUS PARTICLES FOR VIBRATION; and that,*

IX. *The particles of bodies or mediums having different periods of vibration for transmission HAVE DIFFERENT RANGES OF MOVEMENT so as to refract the lines of force transmitted to different extents and so separate portions of the stream having DIFFERENT PERIODS OF INTERMISSION INTO DIFFERENT PATHS; as in refraction of colors.*

Something like this very singularly coincides with the peculiarities of light with respect to spectra, absorption, reflection, refraction, vision, color, chemical action and heat; and also with the conclusions already reached in regard to the mysteries of polarization; while only following out the consistency of mechanics.

But, more singular still, after these propositions are worked out as simple resultants of a mechanical problem, when we come to look at them in relation to previous ideas, is to find in them, altogether unexpectedly, the antagonistic ideas of Newton and of Euler become "evolved" into each other, as "waves" of "corpuscles." And that, at the same time it is very analogous to the modern theory of gases and of the "fourth state" of matter. While over all is the unseen majesty of Gravic Force carrying on the hosts of heaven in their never ending cycles of action, waiting for it, if possible, to throw some LIGHT upon his ways.

WASHINGTON, D. C., May 27, 1881.

## ASTRONOMY.

DOUBLE STARS.—A collection of "Observations of Double Stars made at the United States Naval Observatory," by Professor Hall, has just been issued from the Government Printing Office at Washington. The list includes, besides a small number of stars observed in 1863, with the 9.6 in. equatorial, all the observations of double stars made by Prof. Hall with the 26 in. refractor since 1875. The whole number of observations is 1614.

THE TRANSIT OF VENUS, 1882.—At the sitting of the Paris Academy of Sciences, on the end of May, the Minister of Foreign Affairs transmitted a letter from the British Ambassador, on the part of his Government, desiring to be informed with which French authorities the Royal Society of London should communicate with the view of an interchange of opinions relative to the observations of the approaching transit of Venus. The letter was referred to a committee already nominated.—*Nature*.

## CORRESPONDENCE.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.]

To the Editor of SCIENCE:—

In "SCIENCE" for May 21, Professor Dolbear replies to my criticism of his papers in a manner which, if unanswered by me, is liable to place me in a false light. I, therefore, again request a portion of your valuable space. Professor Dolbear says that, perhaps, he was not guarded enough in some of his statements, and I perfectly agree with him. His reply, too, seems to me to be "not guarded enough." I should be very loth indeed to ascribe to intention what looks very much like an attempt to drag into scientific controversy the legal maxim, "*Falsus in uno, falsus in omnibus*." When, however, the Professor says that by dealing with the last part of my paper, "it will save saying very much about the first part," it certainly looks as if he tried to apply that maxim. In regard to the quotation from Maxwell's paper published in Vol. XI. of *Nature*, I frankly own that I never saw it till the Professor's reply drew my attention thereto, and I thus publicly express to him my obligations and thanks for having done so. I cannot, however, admit that this investigation of Maxwell's materially alters the situation. Maxwell treats of molecules and Professor Dolbear speaks of atoms, something altogether different. His results are, furthermore, the mathematical consequences of certain hypotheses in regard to the molecules; but these mathematical deductions do not agree with the results of experiment—the ratio of the specific heats deduced from Maxwell's investigation does not agree with the same ratio experimentally determined. And Maxwell says that in this disagreement the greatest difficulty of the Kinetic Theory of Gases lies. Boltzmann's result applies to a rigid body, and is not general, if I understand Maxwell correctly. Now, it would certainly be more in accord with scientific principles to use an experimental constant rather than a purely theoretical one in such calculations as the Professor's.

Professor Dolbear's reply gives the impression that in  $E' - E = \epsilon$ . I regard  $\epsilon$  as a ratio when I clearly state that in  $E' = \epsilon \frac{mv^2}{2}$  it must be the ratio  $\frac{E'}{E}$  if it is anything; and this is clearly inconsistent with its also being the difference  $E' - E$ . As, however, the Professor admits the expression  $E' = \epsilon \frac{mv^2}{2}$  to be wrong, we agree on this point, "There is nothing in the first paper that is a deduction from any mathematical work given," says the Professor. In his first paper, Section III., he obtains the equation  $\frac{m}{m'} = \frac{v'^2}{v^2}$  and says, "That is, the square of their

velocities is inversely as their masses, so that wave length in the ether will vary as the mass of the atom." This looks to me like a deduction from mathematical work, though a strange one. With the second quotation from Maxwell I also perfectly agree, for I did not for a moment think, nor did I say, that ether and ordinary matter are the same. I only maintain that ether *is* matter. To define matter as that which obeys Newton's law of gravitation as Professor Dolbear does, seems to me but little better than to say matter is that which has weight. The defense given for the use of the word density as applied to something which it is claimed is not matter, would, if sanctioned, make sad havoc with the precision of scientific and technical terms. The word density has a definite meaning, and if Professor Dolbear wished to attach to it a new meaning, he should have said so. I confess to no little curiosity to know this new meaning of the word density as applied to ether regarded as non-matter.

I do not by any means wish to restrict Professor Dolbear to one or any other number of planes in arranging his atoms, but I do not see how that improves his position. A radial or triangular prismatic structure is open; and such saturated molecules as HCl, H<sub>2</sub>O &c., could not exist. This is, however, but a minor objection to the hypothesis and need not occupy our attention until the more serious ones are removed. It is but a natural and inevitable consequence of this hypothesis to suppose dissociation at absolute zero. And as we do not know anything about matter at absolute zero the necessity of supposing dissociation at that temperature presents to my mind a very great difficulty in applying the hypothesis of synchronous vibrations to explain even the molecular phenomena of adhesion, cohesion, &c. Had I read Professor Dolbear's description of his highly curious and interesting experiments before writing my criticism I should most assuredly have arrayed these very experiments in evidence against his theory, though I feel by no means sure that the formation of one vortex-ring from two may not be due to friction. If it can be shown mathematically that the same results follow in a perfect fluid, I fear the Professor's experiments make an end of the vortex-ring theory.

Now lest any doubt should arise as to the relative position of Professor Dolbear and myself in this controversy, allow me in conclusion to state the case as it appears to me. Professor Dolbear, a well-known scientist, advances new hypotheses; I, an unknown student of science, object to these hypotheses on the ground of insufficient evidence. Then according to the general rules of argumentation the burden of proof rests with Professor Dolbear, and it is for him to remove my objections either by showing that they are not well taken or by overcoming them by further evidence.

WM. H. DOPP.

BUFFALO, N. Y., May 24, 1881.

## BOOKS RECEIVED.

THE CAT. An Introduction to the Study of Backboned Animals, Especially Mammals. By ST. GEORGE MIVART, Ph. D., F. R. S. 200 Illustrations. Scribner's Sons, New York, 1881.

In this octavo volume of about 600 pages the author has attempted to give what has never been attempted for any other animal in a single volume; viz., a complete account of the domestic cat's anatomy, physiology, embryology and psychology, its place in nature and relations to the external world, its pedigree and origin; in short, its biology.

In the preface the author defines his position, and gives the reason for his book: "The advances of astronomy and geology have produced great changes in men's minds during the last three centuries; biology is pro-

ducing changes as great in the present age. So rapid has been its progress that the natural history of animals and plants needs to be re-written, the field of nature being surveyed from a new standpoint. Such a history may be written in two ways: (1) Living beings may be treated as one whole, their organization being successively portrayed as they exist in the whole series; or (2) one animal (or plant) may be selected as a type and treated of in detail, other types successively more divergent in structure from the first, being described afterwards."

The author has chosen the second plan for this book; and in selecting the cat as type, the principles laid down by Straus-Durckheim and Wyman many years ago, and so clearly presented by Wilder in the *New York Medical Journal* for October, 1879, seem to have guided the author, although he nowhere refers to those writers. The principles are as follows: The type should be of convenient size, abundant and easily obtained; its structure should be nearly enough like man's to render comparisons easy. Such a type may serve as an introduction to the study of the group to which it belongs, and in this book the subject is so treated "as to fit it also to serve as an introduction to Zoology generally, and even to Biology itself."

The opening chapter forms a very pleasant introduction to the subject of the inquiry. It gives the supposed origin of the cat as a domestic animal from the Egyptian cat (*Felis caligata sive maniculata*). Many anecdotes illustrating its character and habits are also given, and its well-known attachment to places is contrasted with the devotion of dogs to individuals. It is stated, as was pointed out in the article in the medical journal referred to above, that different kinds of domestic cats do not differ in size and form as do the varieties of dogs. The difference in appearance is said to be mainly due to the difference in the color, quality and length of the hair. Later in the book (chap. xii.) all the living members of the cat family are described, and many of them are elegantly figured, the figure of the lynx being a good example. Many of the fossil cats are likewise described, the skulls of most being figured, including the curious sabre-tooth (*macharodus smilodon*). The introductory chapter closes with a partial explanation of the "anatomical terms and relations as they exist in the selected type," and a general view of the scope and character of the book.

The plan of the anatomical and physiological part is that followed by most school books upon those subjects, the skeleton or hard parts being given first. The physiological and histological consideration of each system is placed at the beginning of the chapter devoted to the given system. The physiology is, and perhaps properly, what one finds in all good text books of human physiology. Most of the figures of the tissues one recognizes as belonging to the text books of human histology of ten years ago, and the descriptions likewise belong to that date. While one familiar with the tissues of the cat's body would be ready to admit that they may be properly described in terms of human histology, it is to be greatly regretted that the splendid achievements of the last decade have not found place in a work of this character which purports to represent the high-water mark of biological knowledge.

In pleasant contrast with the part just considered is the treatment of the skeleton. The descriptions are excellent, and the subject is rendered more attractive and intelligible by the numerous figures. In fact this part of the book is better and more fully illustrated than any other. The two most striking defects are the descriptions of the articulation of the ulna and carpus (p. 96) and the interarticular ligament of the ribs. The first error is repeated in fig. 60. These errors seem quite inexcusable as the nature of the carpal articulation is very evident in the actual specimen and besides it was pointed out by Straus-Durckheim in his "Anatomie Du Chat"

published thirty-five years ago. The true character of the ligamentum interarticulare was described by Meyer in 1834, and has been verified by later writers. It is so evident too that it is hard to understand how it could escape even a superficial dissector.

The muscular system, as a whole, is well done, and the figures, while they lack the elegance and grace of Straus-Durckheim's, are correct and well chosen. There are, however, a few omissions which it is difficult to account for.

The remainder of the anatomy is not of the same excellence as that of the osseous and muscular systems. The account purports to be equally complete, but it is really a curious and confusing admixture of human and feline anatomy. Every anatomist who has examined with care the structure of the cat must have been impressed with its close resemblance to man's. The resemblance, however, does not always amount to identity, but on the contrary the question of homology is often a very difficult one.

The representation of the salivary glands (fig. 88) looks very satisfactory, but the bodies marked (B) and called "accessory submaxillary glands" certainly are not such, and have no connection with Wharton's duct, as may be demonstrated by a fine injection of the same; and "accessory glands" of the parotid if ever present, are only so as anomalies. With reference to the pancreas it is stated (p. 183) that "The pancreas is a large, racemose gland, composed of, and entirely invested by, peritoneum." Further on (p. 191) the pancreas is said to be covered by peritoneum only on its ventral surface. The entire discussion of the peritoneum is fairly correct for man, but very unsatisfactory if applied to the cat (pp. 181, 190-1). In the description of the villi (fig. 94) the following statement is made: "A section of the small intestine, showing the numerous villi, with their orifices directed toward the central cavity." This ascription of orifices to the intestinal villi will probably strike every one who has ever seen them with astonishment.

In describing the structure of the alimentary canal no mention is made of the muscularis mucosæ; and the relations of the ducts of the liver and pancreas are inconsistent with the facts as shown by Cuvier, Claude Bernard and others.

The anatomy of the circulatory, like that of the alimentary system is very unsatisfactory. There are but few figures, and by a curious mistake the walls of the right ventricle of the heart (fig. 102) are shown as much thicker than those of the left. In the general consideration of the subject—the part applying equally to man and the higher mammals—the author, from the immense amount of material, has made a happy selection of the most salient and important points. But in the special consideration, the descriptions are too nearly identical with those of human anatomy. The parts especially faulty are those referring to the vessels of the axillary and brachial regions, to those of the brain and to the azygos vein. Contrary to the statement on p. 197 valves are usually found in the veins of the kidney and uterus as one can easily demonstrate by dissection or plaster injection.

The nervous system is rather briefly but fairly well treated except in some of its details. The figures are mostly good and correct. In the mesal section of the brain (fig. 129) the fifth ventricle is shown as extending the entire length of the corpus callosum; and the figure of the base (fig. 128) exhibits many features which are characteristic of man rather than of the cat.

In contrast with this, however, it is gratifying to find the author following the latest authorities in cerebral anatomy in denying the presence of the great transverse fissure (fissure of Bichat), and in asserting the vesicular character of the hemispheres (p. 267), although in the treatment of the structure and of the brain fissures no

reference is made either to the paper on the cat's brain in Vol. I., No. 5, of this journal, or to any of the special workers mentioned in that paper. And in treating of the functions of the brain, no mention is made of Ferrier, or to any other writer who has added to our knowledge of the localization of cerebral functions.

The peripheral part of the nervous system is more satisfactorily treated, on the whole, than the central part, and the descriptions are illustrated by several excellent original figures. The general excellence is greatly marred, however, by the statement on p. 271 that "The fourth pair of nerves, called also the trochlear or 'from their function of raising the eye-ball' pathetic, etc." A nerve could hardly be said to move the eye in any direction, and the superior oblique muscle to which the fourth nerve is distributed, *lowers* the eye-ball (Quain, Vol. I., p. 277). The description of the vagus or pneumogastric nerve (p. 275), is correct for man as given in the standard works on human anatomy, but it does not represent even approximately the condition in the cat as the simplest kind of a dissection will show; and the assertion (p. 284) that the gangliated cord of the sympathetic ends in a ganglion impar, as with man, is also incorrect.

The account of sensation and the organs of sense is interesting and mainly satisfactory. The author has, in this case as throughout the entire book, introduced his own speculations almost exclusively wherever, from the present imperfect state of knowledge, it was necessary to use the imagination; and the reader conversant with the foremost writers of the day, will probably often find himself on unfamiliar ground.

However faulty one may consider certain parts of the book, he can but congratulate the author on his treatment of reproduction and embryology. He evidently believes that "Whatever God has made is clean," and hence the subject is treated in the same full and open manner that a botanist would treat the fertilization and development of a plant. As the special embryology of the cat has not been fully investigated, most of the statements, as frankly admitted by the author (p. 317), are those supposed to be applicable to the higher mammals generally. The subject is rendered much more intelligible by the addition of original diagrams.

Chapters XI, XII, XIV and XV, treating respectively of the cat's psychology, its place in nature, its hexicology or relations to environment, and finally its pedigree and origin, may be taken together as forming the philosophical part of the treatise. Probably they will be read and discussed more than any other chapters; and from their connection with the other matter in the book, the estimate made of the author as a philosopher will depend more largely on them than on the author's works (*Genesis of Species*, *Lessons from Nature*), claiming to be almost exclusively philosophical.

Doubtless those who accept the philosophy of Plato and Aristotle will be especially pleased with the chapter on Psychology; but those who believe that some progress has been made over those systems, which were carried to their logical conclusion with such disaster to the human mind in the Middle Ages, will probably experience some disappointment. The manner of treating the subject and the position taken by the author may be gathered from the following quotations: "Psychology denotes the study of all the activities, both simultaneous and successive, which any living creature may exhibit" (p. 365). "The psyche, or soul, then, is that principle of individuation which makes the animal what it is, though it has no existence apart from the matter it vivifies. Yet it is the animal par excellence, the matter of which it is composed being but the subordinate part of the compound but indissoluble unity—the living animal." "The terms 'mind' and 'mental act' are not of course properly applicable to the felt neural psychosis of the cat or of any unratational animal. They are here merely employed analogically in deference to popular usage. The 'mind' prop-

erly denotes the phenomena of our consciousness." (p. 386). "In fact, all the mental phenomena displayed by the cat are capable of explanation by the former list of psychical powers (such as may be understood to take place without deliberation or self-consciousness) without the aid of any of these enumerated in the above catalogue of truly rational faculties, nor could any of the former, by any mere increase of intensity, change into one of the latter, for they differ not in *degree*, but in *kind*." (p. 373-4.)

The chapters of the cat's place in nature and its hexicology taken together are the most comprehensive of any in the book. In them is given a brief sketch of historical geology, of the entire organic world and of the distribution and relation of animals. Then by means of tables the author gives his views as to the position occupied by the cat with reference to the mineral, the vegetable, and the animal world. In summing up the characters of the cats, their position in the animal world is given in the following language: "But the cats are not only such highly developed carnivora. Something may also be said in favor of their being considered the highest mammals—the very flower and culmination of the mammalian animal tree." (p. 491).

The book fittingly closes with a chapter "on the pedigree and origin of the cat." The part on the pedigree is full and excellent, the graphic method being employed to show the supposed position occupied by the cats and the relation they bear to their allies. When, however, the author takes up the consideration of the cat's origin, he forsakes his usually calm and unimpassioned style, and the heat of the polemic is indicated by the frequent occurrence of such words as "absurd, absolute," etc. It must be a matter for surprise and regret that neither Darwin nor Wallace are mentioned by name; and that the theory which has contributed so largely to the splendid achievements of modern biology should be dismissed thus. "The notion that the origin of species is due to 'Natural Selection' is a crude and inadequate conception which has been welcomed by many persons on account of its apparent simplicity, and has been eagerly accepted by others on account of its supposed fatal effects on a belief in a divine creation." (p. 520). One familiar with the growth, development and present status of the doctrine of evolution must read with astonishment the note on p. 526. "This conception (of psychogenesis) put forward in the 'Genesis of Species' (by Mr. Mivart) seems to be practically admitted, even by the author of 'The Origin of Species'." (Mr. Darwin). It is evident from the foregoing quotations that the author has overlooked the closing sentence of the introduction to every edition of "The Origin of Species" where Mr. Darwin says: "Furthermore, I am convinced that natural selection has been the main, but not the exclusive means of modification." One must also suppose him unfamiliar with the later editions of "The Origin of Species," "Variations of Animals and Plants Under Domestication," the reviews of Professor Huxley and others, where the limitations of Natural Selection, recognized in the sentence just quoted from Mr. Darwin, are clearly pointed out.

As a whole the book is quite free from typographical errors, and the few that are present would doubtless have been corrected if the English plates had not been used by the American Publishers. The author's style is usually simple and pleasing when treating of general matters, but the parts requiring exactness are often marred by insufficient or ambiguous statements that must leave the student in perplexity. For example, in describing the pectoral limb the term "fore-leg" is used (p. 89) to indicate the part between the shoulder and wrist, while further on (p. 103) it is used in one sentence for the part between the elbow and wrist, and in the following sentence it is used with the meaning first given.

To add to the confusion the term "fore-arm" is employed occasionally (pp. 89, 90, 93, 95, 100 and 103).

On p. 445 it is stated that the cat's body "consists almost entirely of oxygen, hydrogen, carbon, and nitrogen, and largely of protoplasm." Students would certainly be pardoned for concluding from this statement that protoplasm is an element simply equivalent to oxygen or any of the other elements enumerated. On p. 456, the following sentence occurs: "Our present task is then to see what is implied in saying the cat is a 'beast' or a 'mammal.'" To do this we must know its relations simply as a mammal, to the other forms of vertebrate life, *i. e.*, to the groups Pisces, Batrachia, Branchiata, Reptilia, Aves, Monocondyla, and to all the non-mammalian vertebrates taken together." Here there is no indication whatever that the terms "Branchiata" and "Monocondyla" designate more comprehensive groups than the terms immediately preceding them. Again on p. 524 it is said: "But are not a piece of oak and wood-ashes different substances? Yet does not fire gradually transform the former into the latter?" This sounds like the science of the 13th century; and such a teacher might find himself embarrassed by a student's inquiry of what becomes of alcohol, which under the influence of fire changes neither to visible smoke nor to ashes.

The author's nomenclature conforms as little as possible to the principles of a true scientific terminology so ably presented in No. 38, vol. II, of this journal. He mostly employs the terms of human anatomy, but makes them refer to the natural attitude of the cat instead of to that of man for whom they were designed. Hence such terms as "above," "below" which mean cephalic and caudal respectively in man, mean dorsal and ventral as used by the author, that is, positions differing 90 degrees from those of human anatomy. The use and meaning of the terms are nowhere given, and to add to the confusion, nearly every term proposed in human or comparative anatomy may be found in some part of the book, and often two words are used together, as on p. 176, where the large intestine is said to be "behind" "below" the stomach.

But perhaps the source of greatest surprise and regret to those who are ready to welcome every book of this kind is the absence of references to most of the writers who have contributed to our knowledge of the cat's biology. One unfamiliar with the literature of comparative anatomy would certainly conclude that none but the author had ever made the cat a subject of careful study. No reference is made to Cuvier, and the splendid monograph of Straus-Durckheim on the bones, ligaments and muscles is nowhere mentioned. The frontispiece recalls very vividly the similar, but more artistic figures of Straus-Durckheim. The names of Prof. Huxley and Claude Bernard are absent from the book, and no reference is made to Mr. Wallace or his magnificent work on the Geographical Distribution of Animals. The author might be pardoned for not having seen the scattered papers of lesser writers, but to charge him of ignorance of these would seem about equally objectionable to the accusation of intentionally withholding credit where credit is due.

It is also to be regretted that there is no intimation on the part of the author that there may be errors or omissions in the book, and that no special lines of inquiry are pointed out to the earnest students for whom it was written. In the present state of knowledge, there must be many things concerning any animal that cannot be understood, yet the attempt to treat the biology of an animal in a complete and philosophical manner is a new step, and worthy of all commendation. It is confidently expected that this book, so excellent in plan, will do the best any book can do; it will awaken true interest, and stimulate inquiry in the great field of biology.

SIMON H. GAGE.

#### ROYAL SOCIETY (EDINBURGH).

PROFESSOR HELMHOLTZ, on April 17, in an interesting communication on electrolytic conduction, stated, that the experiments he was about to describe were a continuation of experiments he had formerly made in connection with certain objections that had been urged against Faraday's law of electrolysis. He had already shown that a feeble galvanic current could be passed through an electrolytic preparation of acidulated water, even though the electromotive force was not sufficient to decompose the water. The action of such a current would be, in the first place, to coat the electrodes, the one with hydrogen, the other with oxygen. The hydrogen however speedily combined with the free oxygen in the air and liquid to form water, while the oxygen on the positive electrode as speedily dissipated itself. In this way the polarization in the electrolytic cell was kept down, so that the original current was never wholly destroyed. In the later experiments Prof. Helmholtz had completely removed the air from the neighborhood of the electrolyte. This was effected by an ingenious use of the property possessed by palladium of holding large quantities of hydrogen gas in its pores. With this specially-prepared cell, he found that a feeble current passed through it, fell down to zero in a very short time, the difference of potential due to the polarization of the electrodes quite balancing the original electromotive force. On throwing off the battery the polarized electrolytic cell showed on a delicate galvanometer a reversed current, which rapidly fell to zero from an intensity equal to that of the original current before polarization set in. Another result to which his researches had led him was, that there were no *chemical* forces acting between the molecules of an electrolyte other than those that existed in virtue of what might be called their electric charges—a result which cannot fail to have an important bearing upon the question of chemical constitution.

SIR WILLIAM THOMSON communicated a short paper on the average pressure due to impulse of vortex-rings on a solid. When a vortex-ring is approaching a plane large in comparison to the dimensions of the ring, the total pressure over the surface is *nil*. When a ring approaches such a surface it begins to expand, so that, if we consider a finite portion of the surface the total pressure upon it due to the ring, will have a finite value when the ring is close enough. In a closed cylinder any vortex-ring approaching the plane end will expand out along the surface, losing in speed as it so does, until it reaches the cylindrical boundary, along which it will crawl back, on rebounding, to the other end of the cylinder. As it approaches, it will therefore exert upon the plane surface a definite outward pressure, whose time-integral is equal to the original momentum of the vortex, and a precisely equal pressure as it leaves the surface. Hence, in the case of myriads of vortex-rings bombarding such a plane surface, though no individual vortex-ring leaves the surface immediately after collision, for every vortex-ring that gets entangled in the condensed layer of drawn-out vortex-rings another will get free, so that in the statistics of vortex-impacts the pressure exerted by a gas composed of vortex-atoms is exactly the same as is given by the ordinary kinetic theory, which regards the atoms as hard elastic particles.

PROFESSOR TAIT, in a brief paper on the crushing of glass by pressure, indicated certain results he had obtained by experiments, which were in good accord with the mathematical theory of the strains to which a closed cylindrical glass tube under high pressure is subjected. Of the three stresses, radial, tangential, and longitudinal, which may be regarded as acting upon any elementary portion of the wall of the tube, the two former have a *shearing* effect, to which the crushing of the tube is due. From the few experiments that had been completed it appeared that the shear required to disintegrate ordinary lead glass was about  $1 \pm \frac{1}{250}$ .—Prof. J. Blyth gave an account of experiments which he had made on the cause of the sounds produced in the microphone receiver. He also exhibited another form of telephone, in which the vibrating membrane was attached rigidly to a copper wire dipping into a column of mercury which formed along with the wire part of the circuit. The inductive effect of the current on itself caused the wire and

the attached membrane to vibrate in exact correspondence with the variations of the current.

The following interesting letter from Sir Isaac Newton was recently shown for the first time at a *Conversazione* in London given to entertain Professor Helmholtz.

London; Dec. 15, 1716.

"Dear Doctor: He that in ye mine of knowledge deepest diggeth, hath, like every other miner ye least breathing time, and must sometimes at least come to terr; alt for air.

"In one of these respiratory intervals I now sit doune to write to you, my friend.

"You ask me how, with so much study, I manage to retere my health. Ah, my dear doctor, you have a better opinion of your lazy friend than he hath of himself. Morpheous is my best companion; wthout 8 or 9 hours of him yr correspondent is not worth one scavenger's peruke. My practizes did at ye first hurt my stomach, but now I eat heartily enow as y' will see when I come down beside you.

"I have been much amused by ye singular *φαινόμενα* resulting from bringing of a needle into contact with a piece of amber or resin fricated on silke clothe. Ye flame putteth me in mind of sheet lightning on a small—how very small—scale. But I shall in my epistles abjure Philosophy whereof when I come down to Sakly I'll give you enow. I began to scrawl at 5 mins frm 9 of ye clk, and have in writing consmd 10 mins. My Ld. Somerset is announced.

"Farewell, Gd bless you and help yr sincere friend

(Signed) ISAAC NEWTON.

"To Dr. Law, Suffolk."

Mr. W. Grylls Adams describes in *Nature*, certain electrical effects experienced during a storm on a mountain:

"We reached the top of the Jungfrau Joch at 10.5 A. M., and were met by a violent hail storm, which came rolling up from the northern side of the Col. We at once started to return, and had been walking for two hours down the centre of the Aletsch glacier when the electrical effects began to be felt; we reached the Mörjelen See at 3.15, so that at the time of the occurrence we had reached the lower part of the *névé* which is farthest from surrounding mountain tops, where the glacier is widest. We were enveloped in cloud, above which there were no doubt other clouds charged with electricity, and as they approached we were gradually being charged more and more strongly by induction from the lower cloud, and when the discharges or thunder occurred we were suddenly relieved by an electric shock. A kind of *brush discharge* of gradually increasing intensity went on for some minutes, followed by a sudden shock, and this process of bringing us up to the right state of excitement, to be relieved by a sudden shock, was repeated over and over again several times.

The hissing sounds were first heard in the alpenstocks, and gradually increased in loudness up to the sudden discharge. There were clear indications that as condensers of electricity we were not all of the same capacity. We were roped together in threes: in one set of three I was in the middle, with a guide in front and Mr. Sowerby behind. Whilst the charging was going on I felt the pricking sensation at the waist on the side where the cord was knotted, showing that those who were more influenced by electrical induction were charging the others through the rope which acted as a conductor. Judging by his actions, our guide (a young and active man) was strongly influenced by the charge, whilst Mr. Sowerby, the most staid and venerable of the party, was certainly influenced the least. In the other set of three the elderly J. M. Claret of Chamouni was least affected, whereas Mr. Watson, who was not the youngest of the party, was the most powerfully affected. These facts point to a direct relation between the temperament of the individual and his capacity for being excited electrically or his inductive capacity.

I should add that Mr. Packe has had similar experiences, but apparently, to a less extent, in his walks in the Pyrenees.

## NOTES.

STORAGE OF ELECTRICITY.—A new secondary battery, of greatly enlarged capacity, is now attracting attention in Paris. It is the invention of M. Faure, but is confessedly a development of the well-known secondary battery of M. Planté, which is formed of sheets of lead immersed in acidulated water. The latter gains in capacity as the process of charging and discharging is repeated, through increasing thickness of the layer of peroxide of lead that is slowly formed by the currents. M. Faure has conceived the idea of coating the two electrodes with layers of minium, or the red oxide of lead, and by this means the capacity is greatly increased. The Faure battery is stated to have forty times the power of accumulation of the Planté. A battery weighing 75 kilogrammes will develop 75 kilogrammetres, or one horse-power, during one hour. As to the nature of the action, the electric current appears to change the minium to peroxide on the positive electrode, and to reduce lead on the negative. In discharging, the reduced lead is oxidized, and the peroxidized lead is reduced. The battery was lately exhibited by M. Reynier to the Society for the Encouragement of National Industry. There were 24 couples, weighing seven kilogrammes each, connected to a Siemens machine of medium size; these furnished a work of 47 kilogrammetres, which is about a third of M. Reynier's figures; but the conditions were unfavorable. Next, a band of platinum, three mètres long, 12 millimètres broad, and 4-10ths of a millimètre thick was made to glow; then two incandescence-lamps were lighted. The superiority to the Planté battery was well demonstrated. Some competent physicists speak hopefully of M. Faure's battery as a means of distributing electricity to any house or workshop independently of others that may be supplied, and free from the drawbacks of a system of canalisation. The method is also regarded as very promising for domestic electric lighting. A company, it may be added, has been lately started in Paris by M. Philippart, for obtaining force and light by electricity, by combination of the Reynier and Faure batteries. M. Hospitalier has pointed out the expensiveness of charging the Faure battery with electricity from chemical action.

THERMAL ELECTROLYSIS.—Dr. J. H. Gladstone and Mr. Alfred Tribe found that when sheet silver was plunged into fused silver chloride, or iodide of silver, crystals of silver formed on the sheet. Similarly, when copper was immersed in fused cuprous chloride, copper crystals were deposited on it, and when zinc was placed in melted zinc chloride, or iron in melted ferrous chloride, these two metals crystallized on the plates. They found this to be due, not to a difference in the physical condition of the rolled metals, but to the unequal heating of the different parts of the immersed metals. By the contact theory of voltaism, there will be a difference of potential between the metal and the liquid chloride in contact with it, and this difference of potential will vary with temperature. Since all parts of the immersed metal cannot be supposed always at the same temperature there is the possibility of a current being set up and consequent electrolysis of the salt. This view was corroborated by heating the fused salt unequally, when a crop of crystals appeared on a silver rod plunged in the cooler part of the liquid. Again, two silver rods connected together were plunged, the one in a hotter the other in a cooler part of the fused silver chloride, and at the end of fifteen minutes the latter was studded with crystals of silver, whilst the former was clean. A galvanometer showed a stronger current between the rods the greater the difference of temperature between the parts of the fluid in which they were placed; and transposing the rods reversed this current.

LIGHTNING WITHOUT THUNDER.—M. d'Abbadie.—The author describes a phenomenon of this kind which he witnessed in Africa when a thin fog occupying a narrow valley was suddenly illuminated by sheet lightning. He points out that in this case the ordinary explanation of so-called "heat lightning" as the mere reflection of a storm below the horizon is inapplicable.

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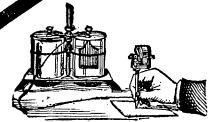
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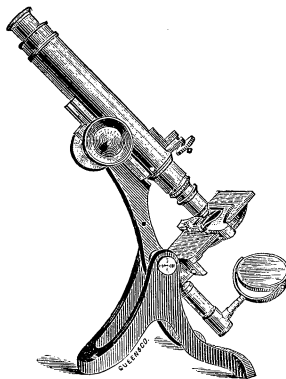
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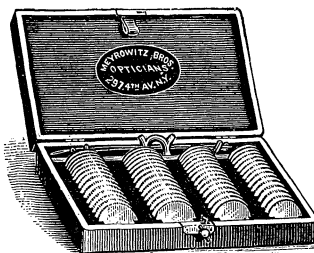
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